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ABSTRACT

Described is a class related to the spread of technology to the developing countries of the world. The class included students from many disciplines. The approach consisted of examining four aspects of technological transfer and impact: the colonial background, agents of change, process of change, and case studies. The author believes these kinds of studies are particularly relevant to the liberal education of engineering students. Central to all such courses is analysis of the engineer's role in the process of social change and development and examination of ways in which engineering impacts on the social values and institutions of society. The diversity, political factors, economic factors, and psycho-social factors of the developing countries are studied. A course outline is included. (LS)

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# TECHNOLOGY IN DEVELOPING COUNTRIES

By David C. Botting

## The Setting

During the latter 1960's the Department of Humanistic-Social Studies began discussing the feasibility of offering courses relating to technology's impact on society and the role of engineering in the economic development of human culture. We, and others in the College of Engineering, were given encouragement by Dean Charles Norris. He also held the concept that the College could serve as a link between Snow's two cultures for all university students. The Department of Civil Engineering gave the initial offering in the new area, "Man and the Pollution of His Environment," in autumn quarter of 1969. My first course, "Technology in Contemporary Western Culture," was presented in the spring of the same academic year. In the succeeding five years other departments of the College have entered the lists and, in addition, closely associated with the College, is a University program on the Social Management of Technology.[1] These new developments have had the aid and encouragement of the present Dean, Dr. W. Ryland Hill, and received aid from a grant from the Sloan Foundation.

My original course is divided into two parts: the first deals with technology's impact on the physical environment and the second with its effects on social change, values and institutions. A second course was introduced in 1973 which examines the interrelation between the growth of science and technology in Western historical societies, ending with the information revolution which took on social significance in the mid 1950's. The present offering logically follows from the others, namely the spread of technology to the developing countries of the world. It was given for the first time this spring quarter.

## Method

The class included students from the following disciplines (all upper-division or graduate, chiefly seniors): electrical, mechanical, chemical, civil and ceramic

engineering, fisheries, microbiology, urban planning, history, public administration, and liberal arts.

The approach consisted of examining four aspects of technological transfer and impact: The colonial background, agents of change, process of change and case studies. These were not taken up in chronological order but rather writ with a broad brush. Another analogy would be that the harmony of the process was studied rather than the individual melodies. My purpose was to tie in the immediate situation in the Third World countries with the effect of the colonial background, the agents and processes of on-going change. This approach together with daily discussion of the texts led to a highly significant and lively degree of class participation in which engineering students interacted among themselves and with those from other disciplines.[2]

I believe these kinds of studies are particularly relevant to the liberal education of engineering students. Central to all such courses is analysis of the engineer's role in the process of social change and development and examination of ways in which engineering impacts on the social values and institutions of society.

## Technology in Developing Countries--the Substance

### Diversity

The social, political and economic configurations of developing countries differ widely while their cultures are as diverse as those of Mexico and Guyana. On the highest level of generalization these countries, which constitute the bulk of the world's population, may be categorized into three groupings. First, those that are close to the traditional stage of societal development. In these only a few of the elite have any conception of what action is required to embark on the hazardous, arduous and lengthy path towards modernization. The process of politicization of the masses into the national culture in most instances has begun only recently and is painfully slow. Literacy is very low. Development of a market

economy is limited to a few cities while the bulk of the population consists of near-subsistence farmers whose economic focus is their village. Examples of these societies may be found in sub-Sarahan Africa (the Union excepted), in the less developed nations of the Middle East and Southeast Asia, and in certain countries of Latin America (e.g. Paraguay and Bolivia). Second, those societies that have created a minimum of social overhead capital and economic infrastructure. As yet these institutions are insufficiently developed for sustained growth. Egypt, Iran, Iraq and Burma would fall into this category. Third, those nations which have approached the take-off stage; Chile, Mexico, and perhaps Colombia would be prime examples here and one might also include Pakistan and India, though in the two latter states the growth is very uneven and in many respects their societies are divided between the traditionalist, subculture of the villages and the modernized subculture of the cities. These countries have programs designed to advance on several fronts; for example, building of an effective secondary school system, creating capital market facilities, improving the transportation network or operating agricultural extension services. They, like the United States in mid-nineteenth century, are in need of capital from abroad to supplement that portion of domestic savings that can be utilized for investment purposes. In all developing countries there is a need for a much larger pool of technically trained manpower than exists at present.

Political Factors

A cursory examination of the history of economically developed societies will reveal that long before embarking on the road toward industrialization their political structures had become stable. This is not to say that progress toward political stability was not, in some instances, interrupted by periods of organized violence. Great Britain, the first nation extensively to use mechanical for muscle power, which was the real essence of the industrial revolution, had reached

a political consensus by the time of the Restoration during which the concept of toleration of the Loyal Opposition grew. This concensus was reaffirmed in 1689 when James II was driven from Westminster and the Bill of Rights became statutory law. In the United States an orderly political development took place during the colonial period and only fourteen years after the embattled farmers stood at Concord the present government had been established. Here, even while the Civil War raged, government in the North was stable and it was the North's industrial capabilities that finally brought victory for the nation at Appommatox. The German Empire under Bismarck was remarkably stable. Under the Tokugowa Shogunate Japan enjoyed domestic peace and order for two and a half centuries and when the Tokugowa power was superseded by that of Emperor Meiji the transition was, with the exception of minor disturbances, quite peaceful. The same observation may be made concerning the legal history of the societies which became industrialized in the late eighteenth and nineteenth centuries. Though in the early period criminal law was harsh and the administration of it imperfect, civil law, particularly in the area of contracts, was for the most part objective and rather well adjudicated. Above all, property rights were protected. Countries of western Europe and those parts of the British Empire that were located in temperate zones all had achieved political and legal stability before becoming economically modern nations.

A similar cursory look at the developing nations of today is discouraging. For many years the aim of their reforming elites has been to establish stable political institutions, a truly independent judiciary and instill a respect for the rule of statutory law into the masses. Yet progress toward maintaining political stability has been hindered by frequent periods of violence, disorder, and palace revolutions followed by new governments that are as often as not headed by strong-armed authoritarians who treat the government as a trophy to be used for personal aggrandizement and the courts as instruments to deprive men and corporations of

property and liberty. In parts of Africa and southeast Asia the order that existed while the colonial powers reigned has been lost. In other areas it has been superseded by quasi-dictatorships or shaky one-party governments. In Latin America, an area in which states gained independence from the metropolitan powers before the end of the first quarter of the nineteenth century, only Chile,[3] Costa Rica, Uruguay, Mexico and recently Venezuela have achieved the ideal of a continued permanent constitutional succession to and tenure in the executive office. Even in wealthy and sophisticated Argentina, the military still have sufficient power and influence to cast aside election returns and force the president to resign from his office. It is concluded that political stability in an independent state cannot be created from the outside. It may possibly be imposed as in the nineteenth century by an outside power. But when the neo-colonial administrators withdraw the process must of necessity begin anew within the context of the indigenous society. The political factors spew into the economic arena. A capricious or vascillating fiscal and monetary policy does not create the kind of atmosphere that is conducive to foreign investment and economic assistance so desperately needed in under developed lands. Neither does an executive or one-party dominated judiciary which rules solely for those in political power in actions involving nationalization of foreign-owned enterprises. One might say, finally, that the degree of efficacy with which foreign aid is utilized is intimately tied to the nature, efficiency and honesty of the government involved.

Economic Factors

In greater or lesser degrees, underdeveloped countries (which for our purposes are those states that have an adverse ratio of animate to inanimate power when compared to advanced economies) have, for the full utilization of their resources, inadequate economic infrastructures and insufficient capital market instrumentalities. One should recall that the London Stock Exchange was established in 1698 and the New York Exchange in 1817. Many types of credit institutions will not exist at all (for

example, secondary markets for home mortgages), a majority of the lending being primarily for consumptive purposes at rates comparable to those charged by the Fuggers in the sixteenth century. The export sector of the economy is usually dependent on two or three primary materials, the sale of which is subject to wide fluctuation in the world market. Therefore the available foreign exchange is in feast or famine supply, resulting in balance of payments difficulties from time to time. Over the long run, overindebtedness will exist in short, medium and long term loans. Thus the typical pattern is to drift toward a point where the country can do no more than service current indebtedness and is unable on bankable terms to obtain new credits, so mandatory if the flow of capital goods imports is to be maintained.[4]

Generally, a very substantial percentage of the population is on the land and most husbandmen are subsistence farmers who use very ineffective techniques of planting, sowing, and revitalizing the soil. In part because of these factors the protein intake is quite low and the caloric value of the diet may be as low as 2,000 a day or considerably less per day as compared with upwards of 2,750 in the advanced societies. This has a cyclical effect in that a poor diet does not produce a hard worker and also the individual is less able to resist disease. The poverty of the peasant class may be intensified by a land tenure system under which a few wealthy individuals or groups own most of the good land while mc[illegible]llers work as tenant farmers or as freeholders of small, economically inefficient plots.

In nearly all developing areas the taxation system is overly dependent on import and export duties and excises, and is usually regressive, resting on those least able to pay and bringing insufficient income to the public sector even though governments are expected to make extensive use of that sector to stimulate economic growth and lay down coordinated plans for the future. In some areas like South Korea, tax farming is still practiced with all the evils that system generates. To meet these ills fiscal policies that result in rampant inflation may be resorted to

in the misbelief that an increase in currency without a corresponding increase in production creates no new wealth and does not enhance the demand side of the market. The market area is usually restricted by two factors: its size and the low level of consumer demand due to low wages on the part of the workers and farmers.

Related to industrial development is the need for expansion of the educational system to teach industrial skills, to create a pool of persons having professional-managerial capabilities, to improve agricultural techniques (and thereby reduce underemployment on the land), and to initiate a massive assault on adult illiteracy.

A final economic factor is the rapid growth of population in relationship to the usable land and the annual increment of increase in productive capacities. Economic development under these circumstances is extremely difficult because savings are hard to achieve. Large numbers of unproductive children make the situation more adverse. To develop, resources must go into investment as well as into consumption, and the production rate must exceed the birth rate. Precluding grants and "soft" loans from the outside, the underdeveloped country may reduce its savings--that is, consume more and invest less--but this is a self-defeating mechanism; or it may lower living standards which are near the cellar and thereby increase savings. Under authoritarian regimes, typified by the Soviet Union in this century and Japan under Meiji, modernization may be achieved by reducing living standards which are already quite low. But neither Japan nor Russia was faced with population increases comparable to that of the underprivileged countries today; Great Britain, the United States, and Germany reached their take-off during a period of about less than 1% annual population increase. Compare this to a figure in excess of 2.8-3.5% each year in Sri Lanka and Latin America today.

Psycho-Social Factors

Lastly, and perhaps of greater importance than any of the foregoing, are the

value systems of the kinds of societies under discussion. The doctrine of progress toward material change was accepted as an article of faith in western Europe and America during the nineteenth century, and by the communist countries in the twentieth. Perhaps it is a crass viewpoint; certainly the degree that material progress helps the spirit of man to attain greater self-realization is a very debatable issue. Nonethetheless, this belief in the doctrine of progress must be accepted by the masses of a society having a backward economy before a western-educated elite can successfully carry out a dynamic program of development. Resistance to and suspicion of the new and different rise out of a number of circumstances. It may be the result of religious convictions. Thus, the massive destruction of grain and fodder by rats and cows is allowed to continue in India though this is admittedly a squandering of resources that could be productively used in a country set on program of industrialization and modernization. It may be because of personal considerations. To the village farmer, reared in a static society in which conditions, interpersonal relations, and modes of production have been identical for generations, the introduction of new techniques threatens to eliminate much that makes life meaningful to him. This farmer may have known his government only as a tax collector and conscriptor of village youths. How readily will he accept the new hybrid seed offered by the agent of a formerly oppressive state? He may resist simply on the basis that increased yield would accrue to the landlord and the tax collector.

Other psycho-social factors which affect economic development are the viewpoint on the necessity for anthe uses of savings, and attitudes towards manual labor, especially in areas where this kind of work has been carried on by lower classes, castes, or by individuals whose skin color is different from the socially dominant element. Saving must be regarded as desirable and its use must be for reinvestment in domestic production rather than to go into temples, monuments, gold hoards, jewelry, Swiss banks, or American and European stocks and bonds. Work must be considered honorable. In sum, what the individual conceives of as being meaningful

and valuable to his spiritual and social well-being, and what kinds of attitudes possess the sanctification of ancient custom, weigh heavily on the question of whether new ideas and techniques will be accepted from abroad and incorporated into the system of values a society embraces.

## DOCUMENTATION

[1]Certain courses offered by the faculty of the Program in the Social Management of Technology have College of Engineering designations, e.g., Civil Engr. 540, "Social Management of Technology I." Courses in Technology in Society offered by the College faculty include the following:

AA 424 (3-5 credits) "Environmental Aspects of Energy Conversion and Heat Engines"
CE 434 (4), "Ecological Effects of Waste Water"
CE 450 (3-5), "Man and the Pollution of His Environment"
Engr 305 (3), "Environmental Radioactivity"
Engr 307 (3), "The Energy Question"
Humanistic-Social Studies (HSS) 201 (5), "Technology and the Future"
HSS 419 (5), "Technology's Impact on the Modern West: 1750-1950"
HSS 420 (5), "Technology in Contemporary Western Culture"
HSS 421 (3), "Socio-Economic Consequences of Technology"
HSS 422 (3), "Contemporary Case Studies in Technology"
HSS 425 (5), "Technology in Developing Countries"
HSS 435 (4) "Impact of Technology on Human Rights"
MET E 403 (3), "Materials in Modern Technology"

[2]Humanistic-Social Studies 425, Technology in Developing Countries.
Purpose: To analyze the alterations in societies of the developing countries resulting from the impact of technology on them, focusing on social change, values, and institutions; and to examine the phenomenon of technological transfer.

### General Outline

(1) Introduction: Colonial background; range of development; stages of development; Japan as an example of technological transfer from Western to non-Western society.

(2) Agents of Change: Colonialism, foreign investment (direct and portfolio); international organization, including United Nations programs for developing countries, World Bank Group, International Monetary Fund, regional organizations (e.g., Inter-American Development Bank), and non-governmental organizations, bilateral programs, stressing those of the United States and the European Economic Community.

(3) Process of Change: Economic factors, including examinations of infrastructures, capital market instrumentalities and consequences of export sector dependence on one or two primary materials the sale of which is subject to wide price fluctuation in the world market, political factors; psychosociological considerations, including examination of the causes for disequilibrium on contemporary post-traditional societies (e.g., population pressures on finite agricultural land, urbanization with

little growth of industrial job availability, traditional vs modern social organization, awareness of the "good life" because modern communication technology has resulted in the "revolution of rising expectations").

(4) Case Studies: Analysis of the process and progress of technological transfer as it applies to particular cultures.

[3]Until the military coup of 11 September 1973 which resulted in the overthrow of President Salvador Allende. Brazil, in spite of the military regime appears to be arriving at a constitutional stage again. See Fernando Pedreira, "Decompression in Brazil?" Foreign Affairs, v. 53, No. 3 (April 1975), 498-519.

[4]Exacerbated by the present high cost of imported petroleum.

## REFERENCES

The following is a partial but selective bibliography:

### Serials

Amerkas
Annals of the American Academy of Political and Social Science
Daedalus: Journal of the American Academy of Arts and Sciences
Environment
Foreign Affairs
Economic Development and Cultural Change
InterAmerican Bank, Annual Reports
Scientific American
Technological Review
Technology and Culture
World Bank Annual Reports

### Books

Brown, Lester R., By Bread Alone. New York: Praeger (for Overseas Development Council) 1974.
Chenery, Hollis B. et al., Redistribution with Growth. New York: Oxford (for the World Bank and Inst. of Development Studies), 1975.
Davidson, Basil, Africa in History (New Rev. Edn.) New York: Macmillan, 1968.
_____, Can Africa Survive? Boston: Atlantic-Little Brown, 1974.
Furtado, Celso, Economic Development of Latin America, Cambridge: Cambridge University Press, 1970.
Hohlo, H. Robert, et al., Nationalism and the Multinational Corporation, New York: Oceana Publications. n.d. [1974]
*Horowitz, Irving L., Three Worlds of Development (2nd Edn.) New York: Oxford, 1972.
Lockwood, William, The Economic Development of Japan (Expanded Edn.), Princeton: Pricenton University Press, 1968.
*Ward, Barbara, The Lopsided World. New York: Norton, 1968.
World Bank (Tims, Wouter) Nigeria: Options for Long Term Development. Baltimore: Johns Hopkins University Press, 1974.

*Course Texts.